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Northwesternmost records of *Vampyressa thyone* Thomas, 1909 (Chiroptera, Phyllostomidae) from Sierra de Atoyac, Guerrero, México

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Abstract

We report new northwesternmost records of the Northern Little Yellow-eared Bat, *Vampyressa thyone* Thomas, 1909 (Phyllostomidae, Stenodermatinae), from Sierra de Atoyac, Guerrero, Mexico. We identified four individuals using morphological characters; two of the individuals were collected at 1,234 and 1,285 m above sea level, altitudes atypical for this species. Captures were recorded between 19:20 and 23:18 h, and all individuals presented signs of reproductive activity. With these data, we increase the scarce knowledge about this rare frugivorous bat.

Keywords

Northern Little Yellow-eared Bat, range extension, shade coffee plantations, Stenodermatinae

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Introduction

The genus *Vampyressa* Thomas, 1900 (Phyllostomidae, Stenodermatinae) currently comprises six species: little Yellow-eared Bat, *Vampyressa pusilla* (Wagner, 1843); northern Little Yellow-eared Bat, *Vampyressa thyone* Thomas, 1909; Melissa's Yellow-eared Bat, *Vampyressa melissa* Thomas, 1926; Quechuan Yellow-eared Bat, *Vampyressa sinchi* Tavares, Gardner, Ramírez-Chaves & Velazco, 2014; Elisabeths's Yellow-eared Bat, *Vampyressa elisabethae* Tavares, Gardner, Ramírez-Chaves & Velazco, 2014; and Voragine's Yellow-eared Bat,

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Vampyressa voragine Morales-Martínez, Rodríguez-Posada & Ramírez-Chaves, 2021. This genus can be morphologically differentiated from others in the Stenodermatinae by the presence of an accessory cusp at the apex of the upper canines, a small foramen in the medial flange of the palatine process of the premaxilla, and a low extension of the caudal border of the pterygoid that is well separated from the foramen ovale (Tavares et al. 2014). Beyond knowing that they are primarily frugivorous, little is known about the feeding habitats, ecology, natural history, and distribution of *Vampyressa* species (Tavares et al. 2014; Rodríguez-Posada et al. 2018; Hernández-Canchola et al. 2019; Ordoñez-Mazier et al. 2020).

Vampyressa bats mainly inhabit South America, with exceptions being *V. elisabethae* from Panama and *V. thyone* from Mexico to northern South America (Lim et al. 2003; Tavares et al. 2014; Morales-Martínez et al. 2021). The latter species is a small canopy bat (head and body length 47–52 mm, weight 10 g); the edge of its uropatagium is nearly naked with few hairs in the center; the tragus, the entire base of the ear, and the upper edges of the ears are yellow (Reid 2009; Téllez-Girón 2014). There are white facial lines around the upper and lower lips (León-Paniagua com. pers.). *Vampyressa thyone* is monotypic, and its geographic range includes Belize, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, French Guyana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Peru, Suriname, and Venezuela (Lim et al. 2003; Hernández-Canchola et al. 2019). This species is apparently rare in Mexico and Central America, with individuals known from only few sites (Téllez-Girón 2014; Ordoñez-Mazier et al. 2020). A single male *V. thyone* was recently reported in eastern Guerrero, Mexico, extending the known distribution of the species to the northwest; given this record, increased sampling effort was recommended for that Mexican state to improve basic knowledge of Neotropical bats (Hernández-Canchola et al. 2019) and mammal species in general (Espinosa-Martínez et al. 2017; Osorio-Rodriguez et al. 2021). As a result of that recommendation, we conducted fieldwork in south-central Guerrero, which allowed for the discovery of new northwesternmost records of *V. thyone*. We report these new records here, increasing the scarce knowledge of the habitat, natural history, and reproductive patterns of this uncommon species in Mexico and Central America.

Methods

We performed field expeditions in February 2021 to Sierra de Atoyac, Municipality of Atoyac de Álvarez, Guerrero, Mexico (Fig. 1A). The climate in the region is warm subhumid, with an annual mean temperature between 22° and 23° C and a maximum annual precipitation of 1660 mm (Cuervo-Robayo et al. 2014). In each sampled site, we recorded the temperature and humidity with a data-logger (EL-USB-2) while mist netting, and we also collected all plant species with a diameter at breast height >2.5 cm that were present in five circular stands (in a 15 m radius), randomly located at no more than 60 m among them; plants were identified and deposited in the herbarium of the Universidad Autónoma de Guerrero.

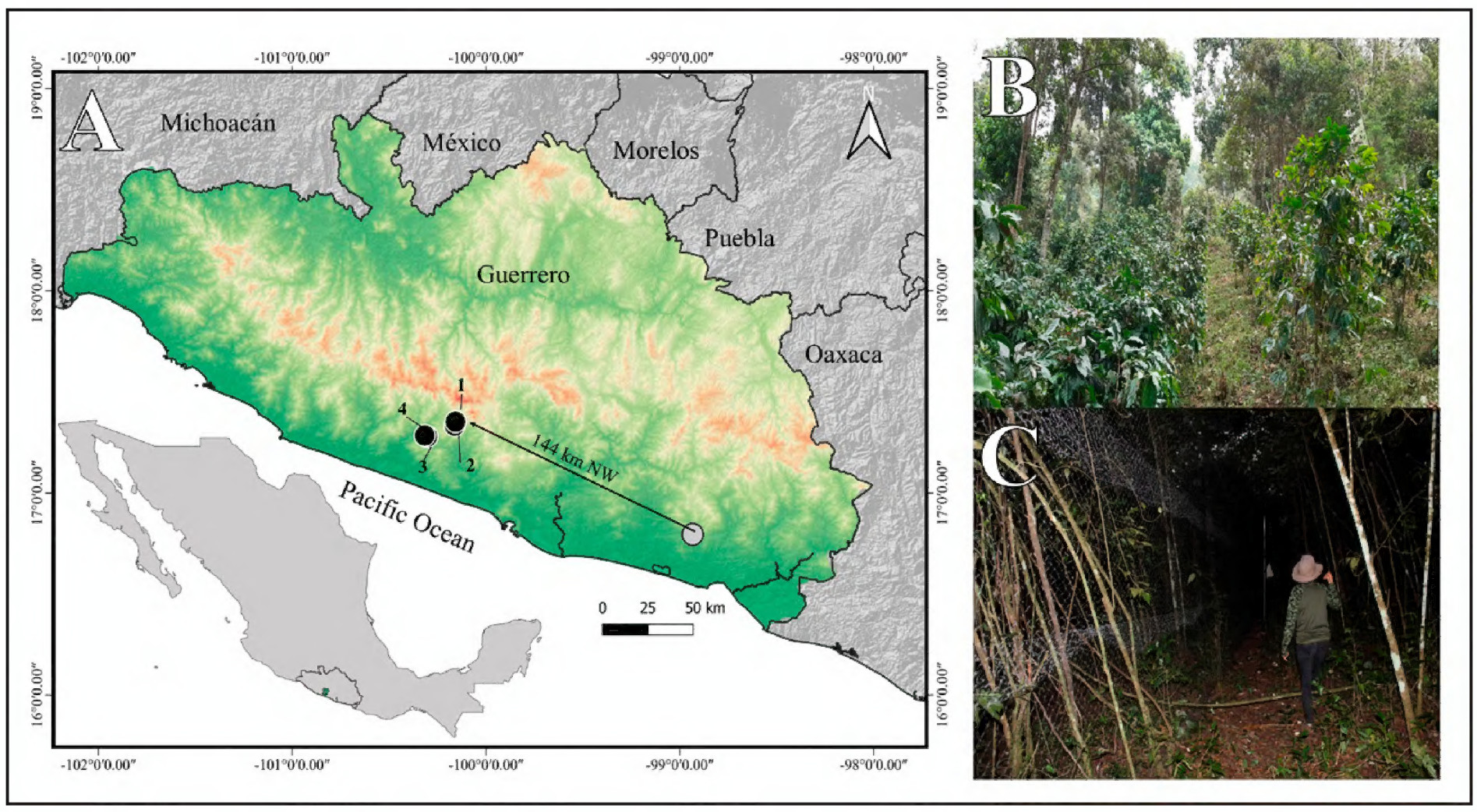

Figure 1. Localities sampled in this work. **A.** Map showing locations of the new records (black dots; see Table 1 and text) of *Vampyressa thyone* in Sierra de Atoyac, Guerrero, Mexico. The grey dot represents the previously reported geographic limit of the species. Topographical features in Guerrero are shown by colors, with low elevations green and highlands brown. **B.** A sampling locality in a shade coffee plantation. **C.** A sampling locality in a secondary forest that had previously been used as a shade coffee plantation over 20 years ago.

We used five mist nets (12 × 2.5 m) set at the ground level in forests with various degrees of disturbance. Mist nets were opened after sunset, checked every 15–30 min, and closed after 6 h of activity. Bats were identified in the field using specialized taxonomic keys (Medellín et al. 2008; Álvarez-Castañeda et al. 2015), and we recorded their sex, weight, and somatic measurements, including forearm, head and body, hind foot, and ear. These measurements were recorded with calipers (Metromex 333-A) to the nearest 0.1 mm according to Romero-Almaraz et al. (2007). This device was also used to record testes length and width, and embryo length and width (measured from the outer surface of the belly). Weight was recorded using a digital scale (Chic-Fantasy SF2012). Before individuals were released, forearms were marked with a vegan and eco-friendly nail polish (Natura). Handling and permanent collection of one specimen was performed following the recommendations and procedures proposed by the American Society of Mammologists (Sikes and the Animal Care and Use Committee of the American Society of Mammalogists 2016). We deposited the collected specimen in the Mammal Collection of the Zoology Museum, UNAM (Facultad de Ciencias, Universidad Nacional Autónoma de México, Ciudad de México, Mexico; MZFC-M). After the skull was clean, we recorded some cranial measurements (greatest length of skull, zygomatic breadth, interorbital width, mastoid breadth, greatest width across upper molars, length of maxillary toothrow, and length of mandibular toothrow) to the nearest 0.2 mm, using digital calipers (Youngo YG-BGJ00002A) and following the protocols provided by Álvarez et al. (2004) and Hernández-Canchola et al. (2019). Diagnostic cranial characters of *Vampyressa* analyzed were based on Tavares et al. (2014).

Results

Vampyressa thyone Thomas, 1909

New records. MEXICO – **Guerrero** • 1.20 km NE La Pintada; 17°21′04″N, 100°09′27″W; 1,285 m alt.; 13.II.2021; Angel N. Osorio-Rodriguez leg.; MZFC-M 15763, ♂ adult with inguinal testes (6 × 4 mm), taxidermized skin with separated skull. • 1.60 km SE La Pintada; 17°19′58″N, 100°09′45″W; 1,234 m alt.; 14.II.2021; Angel N. Osorio-Rodriguez obs.; 1 ♂ adult with inguinal testes. • 741 m SE El Porvenir; 17°16′42″N, 100°18′09″W; 902 m alt.; 16.II.2021; Angel N. Osorio-Rodriguez obs.; 1 ♀ adult pregnant (external embryo measurements = 19 × 13 mm). • 867 m W El Porvenir; 17°17′01″N, 100° 18′56″W; 935 m alt.; 17.II.2021; Cinthia Castro-Flores, Angel N. Osorio-Rodriguez obs.; 1 ♀ adult pregnant (external embryo measurements = 20 × 14 mm) (Table 1).

Two individuals were captured in shade coffee plantations where the understory had been removed to farm *Coffea arabica* (localities 1 and 3; Fig. 1B). The other two individuals were found in secondary forests that had been previously used as shade coffee plantations more than 20 years ago (localities 2 and 4; Fig. 1C). In the localities where we captured *V. thyone*, we also sampled the following bat species: *Artibeus jamaicensis* Leach, 1821; *A. lituratus* (Olfers, 1818); *Carollia subrufa* (Hahn, 1905); *Centurio senex* Gray, 1842; *Dermanura tolteca* (Saussure, 1860); *D. phaeotis* Miller, 1902; *Desmodus rotundus* (É. Geoffroy, 1810); *Sturnira hondurensis* Goodwin, 1940; *S. parvidens* Goldman, 1917 (all Phyllostomidae); and *Eptesicus furinalis* (d'Orbigny, 1847) (Vespertilionidae). The sampling locations were at altitudes between 902 and 1,285 m, and the bats were captured at temperatures ranging from 14 to 16 °C and between 61 and 97% relative humidity (Table 1).

Table 1. Capture data of the new records of *Vampyressa thyone* from Sierra de Atoyac, Guerrero, Mexico. FA = forearm length (mm); W = weight (g); tc = time of capture; TC = temperature at the collecting time (°C); DPT = dew point temperature (°C); and HC = humidity at collecting time (%rh).

Bat specimen	Locality	Sex	FA	W	tc	TC	DPT	HC	Plant composition	
1 (MZFC-M 15763)	1.20 km NE La Pintada (Loc. 1)	M	31	8	23:18	14	7.1	61	*Alchornea latifolia* *Byrsonima crassifolia* *Cecropia obtusifolia* *Chrysophyllum mexicanum* *Clethra fragrans*	*Inga vera* *Magnolia mexicana* *Persea* spp. *Pinus oocarpa*
2	1.60 km SE La Pintada (Loc. 2)	M	31	11	19:20	14.5	10.8	78.5	*Alchornea latifolia* *Bixa orellana* *Cecropia obtusifolia* *Citrus* sp. *Clethra fragrans* *Coffea arabica*	*Cyathea* sp. *Inga vera* *Musa paradisiaca* *Psidium guajava* *Trema micrantha*
3	741 m SE El Porvenir (Loc. 3)	F	31	13	22:09	15	14.5	97	*Bursera simaruba* *Cedrela odorata* *Erythrina* sp. *Gliricidia sepium* *Guazuma ulmifolia*	*Inga vera* *Mangifera indica* *Quercus crispifolia* *Tabebuia rosea*
4	867 m W El Porvenir (Loc. 4)	F	32	12	19:50	16	14.1	85.5	*Alchornea latifolia* *Bursera simaruba* *Cecropia obtusifolia* *Cedrela odorata* *Clethra fragrans*	*Coccoloba barbadensis* *Coffea arabica* *Mangifera indica* *Myrsine juergensenii* *Piper aduncum*

Figure 2. *Vampyressa thyone* from Sierra de Atoyac, Guerrero, Mexico. **A.** Adult male from locality 1, collected and deposited in the MZFC-M. **B.** Adult male from locality 2. **C.** Pregnant female from locality 3. **D.** Pregnant female from locality 4. Localities 1 and 3 were shade coffee plantations, and localities 2 and 4 were secondary forests that had been used as shade coffee plantations over 20 years ago.

Identification. *Vampyressa thyone* can be easily differentiated from most other *Vampyressa* species by its smaller size (forearm lengths in mm are: *V. thyone* = 29.3–34.0, *V. pusilla* = 32.3–36.0, *V. elisabethae* = 36.1–37.8, *V. voragine* = 37.0–37.8, *V. melissa* = 36.7–39.8, *V. sinchi* = 39.1–41.5) (Lim et al. 2003; Tavares et al. 2014; Hernández-Canchola et al. 2019; Morales-Martínez et al. 2021). The forearm length in *V. thyone* only overlaps with *V. pusilla*, but the latter is restricted to southern Brazil, Paraguay, and northern Argentina, and *V. thyone* has a smaller and less robust skull and dentition, compared with *V. pusilla* (Lim et al. 2003). Similarly, in Mexico *V. thyone* can be promptly differentiated from all other Mexican stenodermatine bats by its small size (Medellín et al. 2008; Ceballos 2014). The external morphological traits used to identified *V. thyone* in the field were as follows: short forearm (<34 mm); yellow tragus; upper edges and entire base of the ears also yellow; elongated and narrow nose leaf; white facial lines around upper and lower lips; and nearly naked edge of the uropatagium, with few hairs in the center (Medellín et al. 2008; Reid 2009; Téllez-Girón 2014; Álvarez-Castañeda et al. 2015) (Fig. 2; Table 1). Examining the cranium of one collected specimen (MZFC-M 15763), we also observed the

accessory cusp on the upper canines, and the low extension of the pterygoid, which was well separated from the foramen ovale (Tavares et al. 2014). This is an adult male recorded with inguinal testes (6 × 4 mm) and presenting the following measurements: head and body length = 51 mm; length of hind foot = 9 mm; ear length = 15 mm; forearm length = 31; and weight = 8 g. Additionally, the cranial measurements of this specimen were: greatest length of skull = 18 mm; zygomatic breadth = 10.3 mm; interorbital width = 4.5 mm; mastoid breadth = 9 mm; greatest width across upper molars = 7.3 mm; length of maxillary toothrow = 6 mm; and length of mandibular toothrow = 6.1 mm (Fig. 3).

Data resources. The data underpinning the *Vampyressa thyone* reported in this paper are deposited at Naturalista-CONABIO, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, and are available at https://www.naturalista.mx/observations/126279470, https://www.naturalista.mx/observations/126281075, https://www.naturalista.mx/observations/126282052, and https://www.naturalista.mx/observations/126282557.

Discussion

The four individuals of *Vampyressa thyone* from Sierra de Atoyac (Guerrero, Mexico) represent new northwesternmost records for this Neotropical bat. These records extend the previously reported geographic range of the species by more than 144 km and are the second record of the species in the state of Guerrero (Hernández-Canchola et al. 2019). *Vampyressa thyone* has been mostly collected in elevations between sea level and 1,000 m, and generally below 500 m (Téllez-Girón 2014; Tavares et al. 2015), but atypical records, as reported here for the two male *V. thyone* (1,234 and 1,285 m) are also available for Venezuela (above 1,500 m; Eisenberg 1989), Colombia (1,900 m; Alberico et al. 2000), and even for southwestern Oaxaca, Mexico, where samples were obtained above 2,000 m (Arnold and Schonewald 1972). Our findings reinforce, therefore, that *V. thyone* can also be found at higher altitudes. Still, in respect to habitat, this bat is commonly found in very wet habitats, such as near streams in gallery forests (Téllez-Girón 2014), and all individuals we captured were found in high-humidity conditions (Table 1). It has been reported that *V. thyone* is most active between 18:00–21:00 h (Davis and Dixon 1976; Bonaccorso 1979; Ordoñez-Mazier et al. 2020). However, two of the four individuals in Sierra de Atoyac were reported between 22:09–23:18 h. Additional sampling in this area is needed to determine whether *V. thyone* has a different activity pattern here than in other localities.

The occurrence of pregnant *V. thyone* at our study site in February is consistent with previously reported reproductive patterns for the species; in Colombia, Costa Rica, Guatemala, Honduras, Mexico, Nicaragua, and Panama, pregnant females have been reported from November to August, and lactating females have been found from January to August (Bonaccorso 1979; Wilson 1979; Lewis and Wilson 1987). According to additional behavioral data on *V. thyone* from Costa Rica, this bat roosts in tents made from modified leaves (Timm 1984; Kunz et al. 1994; Rodríguez-Herrera et al. 2001). As far as we know, there is no information about roosting of *V. thyone* in Mexico, but we did not observe any of the plant species reported to be modified by this bat in our study site (Timm 1984; Kunz et al. 1994; Rodríguez-Herrera et al. 2001; Table 1). If individuals from Sierra de Atoyac had similar ecological requirements to those captured elsewhere, they could be using disturbed ecosystems for foraging but not for roosting, as has been seen in other Neotropical bats (Hernández-Canchola and León-Paniagua 2020; Hernández-Canchola et al. 2021). Further research on

Figure 3. Dorsal, ventral, and lateral views of the skull and lateral view of the mandible of *Vampyressa thyone* (MZFC-M 15763) from Sierra de Atoyac, Guerrero, Mexico. Scale bar = 5 mm.

this topic is also needed, especially if we consider that in Mexico and Central America *V. thyone* is a rare species, possibly dependent on mature and well-preserved forests (Ordoñez-Mazier et al. 2020), but at the present, this bat is not recognized in any threat category in Mexico or globally (SEMARNAT 2010; Tavares et al. 2015).

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Authors' Contributions

Conceptualization: AJA, GHC, ANOR. Formal analysis: GHC, CCF, ANOR. Funding acquisition: AJA, ANOR, MRG, JZT, LAGL. Writing – original draft: MRG, JZT, CCF, ANOR, GHC. Writing – review and editing: GHC, JZT, MRG, LAGL, ANOR.

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